U.S. NUCLEAR REGULATORY COMMISSION EXPERIENCE IMPLEMENTING A RISK-INFORMED GRADED APPROACH FOR INSTITUTIONAL CONTROLS TO RESTRICT SITE USE

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ABSTRACT

The U.S. Nuclear Regulatory Commission (NRC) regulates the decommissioning and license termination of approximately 60 complex, commercial nuclear facilities, including power reactors, research and test reactors, material sites, and fuel cycle facilities. Its primary decommissioning regulation, License Termination Rule (LTR) in 10 CFR 20, Subpart E, provides requirements for decommissioning and license termination with either no restrictions on future land use (i.e., unrestricted use) or restrictions (i.e., restricted use). Although NRC prefers license termination with unrestricted use, it recognizes that a few licensees may not be able to meet the requirements for unrestricted release; thus, institutional controls to restrict the future use of the site could be approved. NRC and licensee experience during the past few years has shown that arranging the required legally enforceable institutional controls and independent third party agreements has not been successful. As a result, this issue has complicated developing plans for decommissioning and delayed progress at a few sites. To resolve this issue, NRC developed: 1) a risk-informed, graded approach for selecting institutional controls; 2) NRC possession-only license for long-term control; and 3) NRC monitoring institutional controls after license termination using a legal agreement and deed restriction. Since these options were approved by the Commission, the NRC staff has been working to implement the first two options at the Shieldalloy Metallurgical Corp (SMC) site in New Jersey and the West Valley Demonstration Project site in New York. The purpose of this paper is to provide general background about NRC's restricted use requirements, discuss its new policy options, summarize the progress implementing these options at the two sites, and identify plans for future work.

INTRODUCTION

The U.S. Nuclear Regulatory Commission (NRC) regulates the decommissioning and license termination of approximately 60 complex, commercial nuclear facilities, including power reactors, research and test reactors, material sites, and fuel cycle facilities. Its primary decommissioning regulation, the License Termination Rule (LTR) in 10 CFR 20, Subpart E, provides requirements for decommissioning and license termination with either unrestricted use or restricted use [1]. NRC's decommissioning experience and lessons learned from using the LTR since it was promulgated in 1997 revealed some important implementation issues impacting the decommissioning of NRC

licensed sites. One of these issues deals with using institutional controls to restrict future site use. This issue has complicated developing plans for decommissioning and delayed progress at a few sites. The purpose of this paper is to provide general background about NRC's restricted use requirements, discuss its new policy options, summarize the progress implementing these options at the two sites, and identify plans for future work.

Background

To better understand this issue, some background about the LTR requirements for institutional controls, as well as related implementation issues is important. Although NRC prefers license termination with unrestricted use, it recognizes that a few licensees may not be able to meet the requirements for unrestricted release; thus, institutional controls to restricted the future use of the site may be necessary. Before NRC approval, a licensee must submit its plans for decommissioning for NRC review, along with a demonstration that it can meet the LTR requirements for restricted use. Initially when the LTR was promulgated in 1997, the restricted release approach consisted of license termination with the required legally enforceable institutional controls and the owner/former licensee maintaining the institutional controls and conducting maintenance if needed. There was no NRC role after the NRC license was terminated. Instead, the owner was also required to make arrangements for an independent third party who could maintain controls and maintenance. The independent third party would use funds from an independent financial assurance fund that the owner is required to establish before the license is terminated.

The licensee must also reduce residual contamination to meet the LTR dose criteria for restricted use, which consist of 0.25 milliSievert (mSv/yr) (25 mrem/yr) when institutional controls are in place and 1mSv/yr (100 mrem/yr) or 5mSv/yr (500 mrem/yr) dose "caps" assuming institutional controls are not in effect (10 CFR 20.1403). These dose "caps" serve as a "safety net" by limiting the dose to the public dose limit of 1mSv/yr (100 mrem/yr) should institutional controls fail in the future. A dose "cap" of 5mSv/yr (500 mrem/yr) could be approved by NRC if meeting the 1mSv/yr (100 mrem/yr) dose "cap" is either not technically achievable or prohibitively expensive. For such cases, durable institutional controls are required, such as State or Federal government ownership or control. In addition, five-year reviews would be required for added assurance that if institutional controls were to fail, the five-year review would identify the problem and arrange for the necessary corrective actions. In addition to these dose criteria, licensees must also demonstrate that restricted use is "as low as reasonable achievable" (ALARA). The LTR also requires a licensee to seek advice of affected parties in the early stages of planning institutional controls. Licensees must document the advice received and discuss how the advice was considered or incorporated into the licensees plans.

In summary, the LTR requirements in 10 CFR 20.1403 described above provide a layered and defense-in-depth approach by requiring: 1) legally enforceable institutional controls; 2) durable institutional controls and five-year reviews for sites that need greater protection; 3) an independent third party acting as a backup to take over controls should

the owner not be able to maintain controls; 4) sufficient financial assurance to provide an independent source of funding to maintain controls and maintenance; 5) dose "cap" requirements to limit doses should institutional controls fail.

As previously mentioned, NRC and licensees have had difficulty implementing the LTR requirements for restricted use. For example, States have not been agreeable to becoming the independent third party to act as a backup to an owner and often oppose the restricted use approach. Similarly, NRC's efforts to make arrangements for DOE to take ownership of commercial sites and provide the necessary access and land use controls or maintenance under the provisions of Section 151(b) of the Nuclear Waste Policy Act of 1982 have not been successful. Finally, for sites with long half-life radionuclides such as uranium and thorium, long-term effectiveness of institutional controls is recognized as a significant challenge given many examples of institutional control failure even after short periods of time [2].

Licensees reacted to the institutional control issues in different ways. One licensee was successful, after two years of effort, in getting NRC approval to change the classification of its nuclear material so that it could decommission under a different statute and NRC regulation that requires DOE to accept ownership and control. However, this process has delayed cleanup and decommissioning. The owner of a formerly terminated licensed site also delayed its cleanup for about three years while it proposed a different regulatory criterion for its cleanup because it was no longer a licensee. NRC evaluated the proposal and decided that it was not acceptable, and that the LTR requirements applied to this non-licensee. Finally, a few licensees have spent many millions of dollars on cleanup to meet the unrestricted release criteria to avoid additional delays and uncertainty about acceptable institutional controls.

In response to these challenges and decommissioning delays, NRC evaluated the institutional control issues and developed new policies that should help resolve the issues. These evaluations and new policies are described in a May 2003 Commission paper, SECY-03-0069 [3], and a May 2004 Regulatory Issue Summary, RIS-2004-08 [4]. The purpose of this paper is to discuss these new policies, NRC experience implementing the policies, and plans for future work

NEW COMMISSION POLICY

Risk-Informed Graded Approach for Institutional Controls

The first of the three new policies is a risk-informed graded approach to selecting institutional controls under the LTR so that licensees can have flexibility to arrange the appropriate level of controls. The risk-informed, graded approach consists of risk framework and associated grades of institutional controls. The general risk framework is defined by the hazard level and likelihood of hazard occurrence. The hazard level is established in the LTR (10 CFR 20.1403 (e)(ii)) as the dose level of 1 mSv/yr (100 mrem/yr), calculated assuming institutional controls are not in effect. This dose level is the public dose limit. Sites with calculated doses above the public dose limit but below 5

mSv/yr (500 mrem/yr) are considered higher risk sites. Those sites below the public dose limit are considered lower risk sites. In addition, higher risk sites are those with longer hazard duration (i.e., longer half-life, greater than 100 years). The LTR also defines the general grades of controls: sites below the 1 mSv/yr (100 mrem/yr) dose level require legally enforceable institutional controls, and sites above the 1 mSv/yr (100 mrem/yr) dose level require both legally enforceable and durable institutional controls. Thus, the LTR requires that institutional controls provide more reliable or sustainable protection over the time period needed (i.e., durable) for higher risk sites that could exceed the public dose limit when calculated assuming no restrictions. Durable institutional controls are also appropriate for long-lived radionuclides regardless of the dose limit.

Specific grading of institutional controls can be selected within the two general grades defined above. This approach recognizes that the site-specific factors affecting risk can be highly variable from site to site. As a result, specific grading recognizes the need for flexibility to tailor institutional controls to achieve the desired effectiveness. Specific grading involves evaluating and balancing numerous site-specific factors such as: a) physical characteristics of the site that limit future land use; b) land uses that could be adverse to performance/compliance and therefore should be prohibited; c) land uses that are acceptable and could result in productive reuse of the site; d) dose assessment results; e) engineered barriers and related maintenance; f) monitoring controls and maintenance; g) jurisdictional limitations on enforceability and long-term effectiveness of institutional controls; and h) advice from affected parties, such as local governments and the public.

The graded approach has important benefits. For the public, protection is increased, especially over the long term. The approach clearly identifies when durable controls might be needed and specific controls would be designed to mitigate site-specific risks that are significant to maintaining safety. For licensees and NRC, clearer guidance is provided for licensees to select institutional controls and NRC to review licensees proposed controls. Licensees also have the flexibility to select appropriate controls that could be less costly and easier to arrange.

Institutional Controls involving NRC

If a licensee cannot establish acceptable institutional controls or independent third party arrangements, two new NRC policy options have been approved for licensee consideration: 1) NRC Long Term Control (LTC) license after completion of remediation; and 2) NRC monitoring and enforcement under a legal agreement and deed restriction. The LTC is preferred by NRC because NRC licensing and enforcement is a proven approach. Therefore, this approach is considered to be the most effective and efficient approach to establish and sustain. However, for some cases, owners may request license termination, or the site might be a formerly terminated licensed site whose current owner does not want to become a licensee. For these cases NRC monitoring and enforcing under a legal agreement and deed restriction might be considered. However, NRC has no experience with establishing and sustaining this approach, nor has it been legally tested. These two options are discussed below.

The LTC license option would involve amending the existing specific license for decommissioning to a LTC possession-only specific license, after completing remediation and after LTR dose criteria are met. For such sites, the LTC license acts as an institutional control to maintain the restrictions necessary to meet the LTR criteria. NRC would monitor, inspect, and enforce under its licensing authority and, therefore, would act as the independent third party. For this option, required dose criteria, environmental reviews, advice from affected parties, and sufficient financial assurance would continue to be required. Financial assurance would, for this case, be based on a cost estimate for NRC monitoring and inspection fees, as well as the licensees cost for surveillance and maintenance. Although this option is new for the LTR, it has been developed by NRC to be very similar to the general license used for uranium mill tailings sites. For these sites, DOE provides the controls on access and land use and well as other functions such as surveillance, monitoring, maintenance, reporting, and records retention under the NRC general license. NRC and DOE have over 10 years of experience with controls at these sites and the LTC license would involve similar licensee and NRC activities to those that have been developed and used by DOE and NRC over the past 10 years. This option is also similar to the State of Ohio's possession-only license. When Ohio became an NRC Agreement State in 1999, NRC found Ohio's possession-only license approach to be compatible with the LTR. Ohio currently plans on using the possession-only license for the Shieldalloy Metallurgical Corporation (SMC) site in Cambridge, Ohio.

The second option involves a legal agreement between NRC and the owner along with a restrictive covenant for the owner to provide the necessary access and land use restrictions with NRC monitoring and enforcing the controls. Monitoring could include the owner agreeing, as a condition to license termination and included in a restrictive covenant, to provide an annual written assurance that certifies the effectiveness of controls as a simple way to notify NRC and other parties. By including the annual written assurance in the restrictive covenant, future owners would be required to also provide access and land use controls along with an annual assurance to NRC and other parties. This option would also involve the licensee or owner establishing sufficient financial assurance for the long-term cost of NRC monitoring and other actions. The licensee/owner would need to agree to pay NRC annually for the activities
NRC conducted.

IMPLEMENTING NEW OPTIONS

NRC has started to implement the risk-informed graded approach and institutional controls involving NRC at three sites: SMC in New Jersey, West Valley Demonstration Project in New York, and AAR in Michigan. The SMC and West Valley cases are discussed below. The AAR case is not included because work is in the early stages of development at this time.

Shieldalloy Metallurgical Corporation, New Jersey

The SMC site provides the first example of the use of NRC's risk-informed, graded approach and considering the new LTC license. The 68 acre SMC site is located in the town of Newfield, New Jersey. The primary portion of the site consists of 60 acres with manufacturing facilities and support areas, while an eight acre storage yard contains 40,000 cubic meters of slag and baghouse dust containing natural uranium and thorium. The slag and baghouse dust resulted from smelting pyrochlore, a concentrated ore containing columbium (niobium) that SMC used in manufacturing specialty steel and super alloy products. The pyrochlore ore contained enough uranium and thorium to be classified as "source material" and therefore required an NRC license.

In 2002, SMC submitted a decommissioning plan to NRC for restricted release but did not identify specific legally enforceable institutional controls or government entities that had agreed to take responsibility. As a result, NRC rejected the decommissioning plan. After discussions with NRC, SMC indicated that it would revise its decommissioning plan and propose using NRC's LTC license to resolve its institutional control issue. Subsequently, NRC developed and provided SMC with interim guidance on the LTC license so that it could revise its decommissioning plan and submit it to NRC for review [5]. The interim guidance for SMC describes LTC concepts and identifies the information that would need to be provided in the revised decommissioning plan. The interim guidance addresses the following concepts: purpose and content of the LTC license; roles and responsibilities; LTR restricted use requirements; eligibility for restricted use; transfer of ownership; minimizing the size of the restricted area and subdividing the control of site areas; sufficient financial assurance and trust fund; NRC's oversight activities and fees; engineered barriers; dose assessments; long-term record retention and availability; and finality of decommissioning decisions.

Some of the key concepts from the interim guidance are summarized below to provide a general understanding of NRC's approach. First and foremost, although NRC allows restricted use as an appropriate method of decommissioning, license termination with unrestricted use is preferable. As a result, under the LTR (10 CFR 20.1403(a)), NRC has defined eligibility requirements for restricted release that the licensee must first meet. Using a cost benefit analysis, licensees must demonstrate that cleanup to unrestricted release levels would result in net public or environmental harm or that leaving the contamination onsite is as-low-as reasonably achievable (ALARA). In addition, to consider using the LTC license, durable institutional controls would be needed and the licensee would need to demonstrate that it was unable to establish other types of acceptable institutional controls and independent third party arrangements.

The purpose of the LTC license is to provide the legally enforceable and durable institutional controls required by the LTR to ensure the long-term protection of public health, safety, and the environment. The license would specify requirements for: prohibited site access and land use; permitted site access and land use; physical controls such as fences and signs; surveillance; groundwater monitoring if needed; corrective actions; maintenance; reporting; and records retention and availability. Determining

these specific requirements should be based on the results of dose assessments, including sensitivity analyses to identify factors (land uses, natural process, or engineered barrier components) most significant to meeting the dose criteria. It is important to understand, however, that the licensee must still comply with all the applicable requirements of the LTR, including dose criteria, even though the license would not be terminated. These requirements must be met before the existing license could be amended to become the LTC license.

Under the LTC license, the licensee would have the primary responsibility for implementing and maintaining the controls and conducting all the activities under the license. Consistent with its normal regulatory role, NRC would be responsible for assuring that the licensee's controls and maintenance remain effective by conducting oversight reviews, inspections, five-year license renewals, enforcing the license, and maintaining publically available licensing records. Stakeholders have a role under the LTR to provide input early in the planning stages for the LTC license. During implementation of the LTC license, public meetings could be scheduled as part of the five-year licensee renewal process, to obtain information about the site and maintain a local awareness of the site and the restrictions.

The licensee would need to implement the risk-informed graded approach described above to help tailor the specific types of controls, the areas of the site needing controls, and the duration of controls. For the SMC case, although the current license boundaries would be maintained under the LTC license, the overall 68 acre site might be subdivided into areas with different restrictions. For example, much of the site (about 60 acres) could have no restrictions on access and land use and could be used for industrial applications consistent with local zoning constraints. The only restriction on these portions of the site would be to conduct confirmatory groundwater monitoring (if needed) and prohibit the sale separately from the restricted use portion containing the residual contamination. This approach would allow productive reuse of a major portion of the site that could also benefit the local community. The restricted use area of the site could consist of about 8 acres containing a disposal cell and cover (i.e., engineered barriers).

Maintaining ownership of the complete site will help ensure long-term monitoring and will help sustain the owner/licensee controls to protect public health and safety over the long-term. Transfers of site ownership of the total site are expected over the long-term, and the new owner(s) will need to become the licensee and provide the controls as specified in the conditions of the LTC license. The licensee must notify NRC of a potential sale and obtain NRC prior approval of the new owner.

The licensee must establish a trust and place sufficient funds into it to produce annual income that is sufficient to cover the (1) annual average costs of licensee surveillance, control, radiological monitoring of surface and groundwater if needed and routine maintenance, (2) NRC oversight costs, and (3) trustee costs. The licensee's decommissioning plan must contain an estimate of these average annual costs. Generally, such costs should not include ongoing active maintenance and repair of engineered barriers because NRC encourages licensees to design robust engineered

barriers to mitigate potential future failures, simplify long-term control, and not rely on active ongoing maintenance, especially for sites with long-lived radionuclides.

Finally, in the event the licensee does not comply with the license conditions, NRC could take enforcement action, as necessary, to ensure that control activities are maintained. Alternatively, the trustee could be directed by NRC to provide funds to a contractor to work on behalf of the licensee. NRC could also seek a court to appoint a custodial trustee to continue the activities using funds from the trust in the event that no licensee exists.

Although this approach is in the early stages of planning, State of New Jersey officials have expressed concerns with the use of NRC's LTC license for the SMC site [6, 7]. The State of New Jersey's expressed concerns include: 1) the proposed approach would create an unlicensed low-level radioactive waste disposal facility; 2) that there has not been a meaningful opportunity for community discussion; and 3) the radioactive material should be disposed of and not left in place for future generations. NRC address these concerns by explaining that the LTC license provides institutional controls after decommissioning of the site, and therefore is not a low-level radioactive waste disposal facility [8, 9]. The SMC site was never used for the disposal of radioactive materials from other sites, and it is not planned to be used for that purpose in the future. NRC also explained that this policy is the result of many years of NRC experience and that NRC's role enhances the assurance of proper restricted use. Furthermore, restricted use under the LTR has been a decommissioning option available since the LTR was finalized in 1997. Finally, opportunities for public involvement have already occurred during NRC's licensing meetings that are open to the public. Additionally, in the future, there will be many opportunities for community discussion, as required by the NRC regulations, during SMC's development of the decommissioning plan and NRC's review of the plan.

West Valley Demonstration Project, New York

In contrast to the SMC site, the West Valley Demonstration Project site is far larger and more complex and, therefore, will be a good example of applying NRC's risk-informed, graded approach to a more complex site, possibly with a variety of restrictions on future use.

The West Valley Demonstration Project is a waste management project located about 30 miles southeast of Buffalo, New York. The project is being conducted by DOE on a site owned and managed by New York State Energy Research and Development Authority on behalf of the state of New York as mandated by the 1980 West Valley Demonstration Project Act. To complete the project, facilities used for the project must be decommissioned as prescribed by NRC in its 2002 Final Policy Statement for Decommissioning Criteria for the West Valley Demonstration Project [10]. The Final Policy Statement describes how NRC's LTR should be applied to this project. The site is large and complex, containing a variety of waste management areas, primarily located within a 200 acre portion of the approximately 3,300 acre site. These areas include: a reprocessing facility that operated from 1966 to 1972; two radioactive waste disposal areas; an high-level radioactive waste tank farm; waste lagoons; above ground

radioactive waste storage areas; and some soil and groundwater contamination in areas near these facilities.

Currently, DOE is preparing a draft Decommissioning Environmental Impact Statement (EIS) and a decommissioning plan for eventual submittal to NRC. Thus, at this time, a preferred decommissioning approach and specific plans are not available. However, NRC has discussed with DOE and others the Policy Statement, LTR requirements, and guidance for preparing a decommissioning plan, including policy and guidance related to institutional controls in the LTR Analysis (SECY-03-0069 and RIS 2004-08). These discussions included the application of the risk-informed, graded approach to institutional controls. NRC believes that this approach can help decision making by providing a rationale based on risk that can enhance long-term safety as well as be more efficient. As discussed above, the approach allows site-specific tailoring of controls based on magnitude and duration of hazards. Thus, a site could be first subdivided into areas with different risks (dose consequence and duration of the hazard or time period needed for radionucludes to decay to unrestricted use levels). Based on this risk subdivision, a graded, or tailored approach could be planned, including appropriate restrictions on access and land use, types of institutional controls to implement the restrictions, and appropriate time periods that restrictions might be needed. There may be portions of the site that might not need restrictions on access or land use because they were either never contaminated or they could be cleaned up to unrestricted use levels (0.25 mSv/yr (25 mrem/yr)). Of those remaining areas that need restrictions, dose assessments can provide "risk insights" about the natural and human events that are most significant to risk and therefore the appropriate restrictions (e.g., no construction, no groundwater use, etc.), monitoring, and maintenance that might be needed to mitigate these risks. In addition, different types of institutional controls could be considered, such as conventional deed restrictions for low risk areas needing short term restrictions to government ownership or an NRC LTC license for higher risk areas needing more durable and long-term control. Because of the different types of radionuclides and associated half lives present, some areas might need controls for less than 100 years while other areas could need long-term controls. Finally, the party that will be ultimately responsible for institutional controls will be determined in the future, as a result of the ongoing process for developing the EIS.

NRC PLANS FOR DEVELOPING REGULATORY GUIDANCE

NRC plans on developing draft guidance during fiscal year 2005 for its risk-informed, graded approach to institutional controls and new NRC options. The interim guidance for the LTC license at the SMC site will be included along with guidance for NRC monitoring and enforcing under a legal agreement and restrictive covenant. NRC plans on publishing this draft guidance for public comment in September 2005. After considering the public comment and informing the Commission of these comments, the guidance will be finalized in September 2006. This new guidance will update the existing decommissioning guidance in NUREG-1757 [11].

CONCLUSION

Although NRC prefers the decommissioning option of unrestricted release and termination of the NRC license, it recognizes that this option might not be achievable for some cases. Therefore, the LTR provides the restricted use option to licensees that can meet the requirements for restricted use, including establishing legally enforceable institutional controls and an independent third party.

Attempts by licensees to meet these requirements have not been successful and decommissioning has been delayed. As a result, NRC has developed options that would be acceptable for meeting the legally enforceable institutional controls and independent third party requirements.

NRC considers that its new risk-informed graded approach provides flexibility and a risk-logic for selecting appropriate grades and durations of institutional controls.

In addition, new options involving NRC for durable institutional controls for higher risk sites should provide more effective protection over the long-term and provide options if a licensee has not been able to arrange more conventional approaches.

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